

*Office of Environmental Management – Grand Junction*



# **Changes in Vegetation Below the Interim Action Ground Water System at the Moab UMTRA Project Site**

**September 2006**



**U.S. Department  
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**Moab UMTRA Project**

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Grand Junction, Colorado

## 1.0 Introduction

The U.S. Department of Energy (DOE) is in the process of remediating the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Site, a former uranium processing facility located northwest of the city of Moab, in Grand County, Utah. Construction of an interim ground water treatment system began in 2003 to address concerns regarding elevated ammonium levels in ground water entering the Colorado River. The system includes of a series of extraction and injection wells constructed between the site's tailings pile and the river.

In 2004, wetland delineations were performed at the project site, including vegetation assessments. In order to document vegetation changes, four of the sample points, located between the ground water treatment system and the Colorado River, were revisited in 2006. Vegetation was measured semi-quantitatively at and in the vicinity of the sample points and compared to similar measurements taken in 2004.

Four well fields comprise the extraction and injection wells of the interim ground water treatment system. These wells were installed at different times, so some wells have been in operation longer than others above various sample locations. Sample Location 4 is located below the edge of Configuration 1 (installed in 2003). Sample Locations 1 and 2 are located below Configuration 2 (installed in 2004). Sample Location 3 is located below Configuration 3 (installed in 2005).

## 2.0 Methods

In 2004, GPS data were used to document the locations of sample points for wetland delineations. A  $\text{m}^2$ -quadrat was placed at each sample location, and ocular estimates of cover were recorded for each plant species present in the quadrat. The presence and relative abundance (high, medium, low, and trace) of additional species occurring within the vicinity (an approximate 4-meter radius) of each sample were also recorded. The delineations also included an assessment of soils and hydrologic indicators.

In 2006, the four sample locations were revisited to assess vegetation changes. Quadrat samples were taken at each location and semi-qualitative measurements of presence and abundance of nearby plant species were recorded as in 2004.

## 3.0 Results

Quadrat data are summarized in [Figure 1](#) and [Figure 2](#). The data show a substantial decrease in the abundance of *Bassia scoparia* (kochia, or summer cypress), a strong increase in the abundance of *Cyperus erythrorhizos* (redroot flatsedge), and an increase in species diversity between 2004 and 2006. *Tamarix ramosissima* (tamarisk, or salt cedar) was the most dominant species in both 2004 and 2006.

Vicinity data are summarized in [Figure 3](#) and [Figure 4](#). The data show a sharp decrease in the relative abundance of species with a higher tolerance to ammonia, and an increase in the number of species with moderate or low tolerances. The measure of relative abundance was estimated by

assigning a value to each abundance class (4=high; 3=medium; 2=low; 1=trace) and calculating an average value across sample points.

For this study, species were categorized as having high, moderate or low ammonia tolerance. A more thorough literature review would be necessary to categorize all the species with confidence, but data are available for the most common species (summer cypress, tamarisk, sedges and rushes, willows, cottonwood). For the purposes of this study, if the ammonia tolerance of a species could not be determined, it was categorized as low.

In 2004, species with low ammonia tolerances were observed growing in small amounts only near Sample Location 4. Near Sample Locations 1, 2, and 3, all observed species were highly or moderately tolerant to ammonia. In 2006, many species with low ammonia tolerances were observed growing near all sample locations, though many occurred in trace amounts.

## 4.0 Discussion

It is clear from the vegetation cover data that significant changes have occurred in wetland plant composition hydrologically downgradient of the interim ground water treatment system at the Moab UMTRA Project Site. Salt cedar, a species with a wide range of physiological tolerances, was a dominant plant in 2004 and 2006. It has increased slightly in cover, probably as a result of the growth of individual plants. In 2004, the remainder of the vegetative cover was primarily comprised of summer cypress, an ammonia-tolerant, upland species. By 2006, almost all of the summer cypress had been replaced by red root flat sedge, a wetland species moderately tolerant to ammonia. Throughout the wetland areas in 2006, species with lower tolerances, notably Fremont cottonwood, were also beginning to establish.

Wetland delineations in 2004 revealed that at three locations (Sample Locations 1, 2, and 3), summer cypress was co-dominant with salt cedar. Summer cypress is not abundant in other wetlands in the Moab area. It is classified as a “facultative upland” species on the national list of wetland species (National Technical Information Service 1988), which means that in Utah, it usually occurs in non-wetlands (estimated probability 67%—99%). Soil pits and hydrology in these areas conclusively confirmed wetland indicators. In 2006, summer cypress had been replaced by species with strong wetland indicator status, and it occurred only in trace amounts. Though anecdotal, this information is evidence that summer cypress dominated in wetlands with ammonia levels above the tolerances of wetland plants in this area, but was easily out-competed by true wetland species when ammonia levels dropped.

Configuration 1, located above Sample Location 4, had been operational for approximately one year when delineations were performed in 2004. The remaining sample points were in locations that had either not been treated yet (Sample Location 3, below Configuration 3, constructed in 2005), or had only been operational for a few months (Sample Locations 1 and 2, below Configuration 2). In 2004, the only sample location containing species with lower ammonia tolerances was Sample Location 4. This anecdotal evidence supports the idea that ammonia levels had already begun to fall in the areas below Configuration 1, even after just one year of treatment.

A sharp increase in species diversity was observed across the wetland between 2004 and 2006. While some of the increase may be attributable to new species moving into the area, some may also be attributable to the time of year in which delineations were performed. The 2004 delineations were performed in early winter, and the 2006 vegetation assessments were performed in late summer. It is probable that herbaceous trace species were not seen in the winter delineations. However, it must be noted that woody species and the most dominant herbaceous species (summer cypress and redroot flatsedge) are large plants which persist until spring floods and can be reliably assessed in winter.

In summary, the interim ground water treatment system appears to be effectively reducing ammonia levels in the wetland areas below the tailings pile along the Colorado River. This is supported by significant changes in the plant community immediately below the system.

## 5.0 References

Britto, D.T., and H.J. Kronzucker, 2002. “ $\text{NH}_4^+$  Toxicity in Higher Plants: A Critical Review,” *Journal of Plant Physiology*, 159: 567-584.

Clarke, E., and A.H. Baldwin, 2002. *Responses of Wetland Plants to Ammonia and Water Level*. Ecological Engineering, 18(3):257–264.

DOE (U.S. Department of Energy), 2003. *2003 Section 404 Monitoring Report for the New Rifle Wetland*, document number U0173800, prepared for the U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, October.

Meikle, T.W., and W.J. Waugh, 2001. *Influence of Ammoniacal-N on Wetland Species*. Proceedings of the 18th meeting of the American Society for Surface Mining and Reclamation, June 3-7, 2001, Albuquerque, New Mexico.

National Technical Information Service, 1988. *National List of Plant Species that Occur in Wetlands: Utah*, U.S. Department of the Interior, Fish and Wildlife Service, in cooperation with the National Regional Interagency Review Panels, May.

Szögi, A.A., P.G. Hunt, and F.J. Humenik, 2003. “Nitrogen Distribution in Soils of Constructed Wetlands Treating Lagoon Wastewater,” *Soil Science Society of America Journal*, 67:1943–1951.

Plant species	Ammonia tolerance	Sample Location 1		Sample Location 2		Sample Location 3		Sample Location 4		AVERAGE	
		2004	2006	2004	2006	2004	2006	2004	2006	2004	2006
<i>Bassia scoparia</i>	High	50	-	60	-	40	-	-	-	37.5	0
<i>Tamarix ramosissima</i>	High	50	5	35	75	50	100	25	10	40.0	47.5
<i>Cyperus erythrorhizos</i>	Moderate	-	75	5	25	10	-	50	70	16.3	42.5
<i>Salix exigua</i>	Moderate	-	-	-	-	-	-	-	5	0	1.3
<i>Salix gooddingii</i>	Moderate	-	4	-	-	-	-	5	5	1.3	2.3
<i>Chenopodium glaucum</i>	Low	-	-	-	-	-	-	20	-	5.0	0
<i>Eragrostis hypnoides</i>	Low	-	15	-	-	-	-	-	10	0	6.3
<i>Eleocharis palustris</i>	Low	-	1	-	-	-	-	-	-	0	0.3

Figure 1. Estimated Relative Cover by Individual Plant Species in m<sup>2</sup> Sample Quadrats

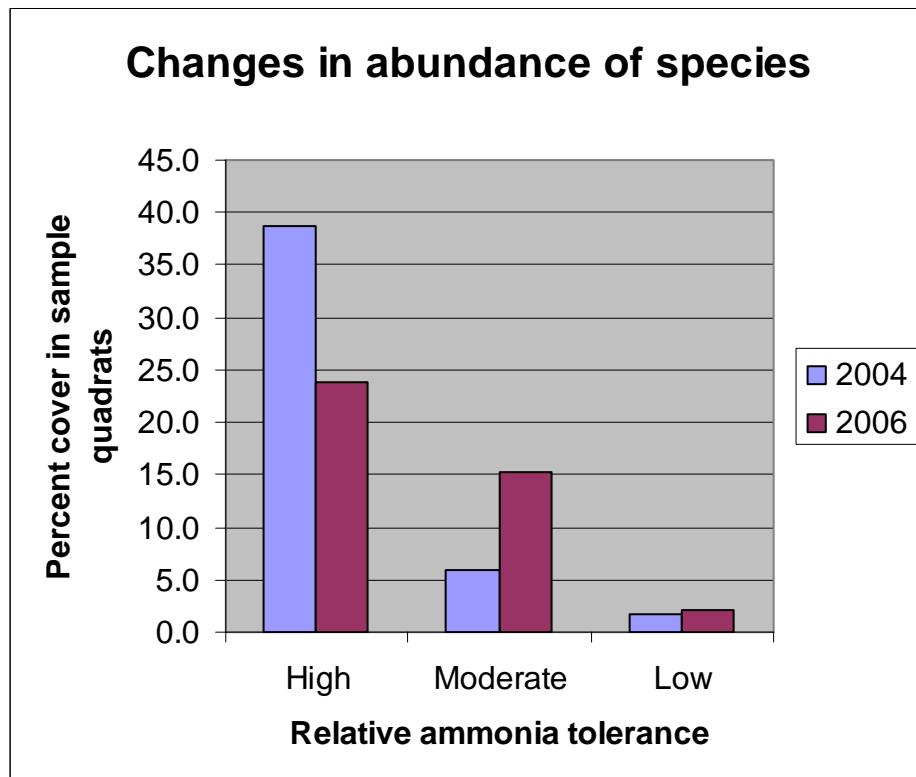


Figure 2. Changes in Abundance of Species with Varying Ammonia Tolerances

Plant species	Common name	NH <sub>4</sub> tolerance	Sample Loc 1		Sample Loc 2		Sample Loc 3		Sample Loc 4	
			2004	2006	2004	2006	2004	2006	2004	2006
<i>Bassia scoparia</i>	Summer cypress	High	4 <sup>a</sup>	-	4	1	4	-	-	-
<i>Beckmannia syzigachne</i>	Sloughgrass	Low <sup>b</sup>	-	-	-	-	-	1	-	1
<i>Chenopodium glaucum</i>	Lambsquarters	Low <sup>b</sup>	-	1	-	-	-	1	3	-
<i>Cyperus erythrorhizos</i>	Redroot flatsedge	Mod.	-	4	2	3	2	4	4	4
<i>Echinochloa crus-galli</i>	Barnyard grass	Low <sup>b</sup>	-	2	-	1	-	1	-	-
<i>Eleocharis palustris</i>	Creeping spike rush	Low <sup>b</sup>	-	1	-	-	-	1	1	1
<i>Eragrostis hypnoides</i>	Teal lovegrass	Low <sup>b</sup>	-	3	-	4	-	-	-	2
<i>Populus fremontii</i>	Fremont cottonwood	Low	-	2	-	1	-	-	1	2
<i>Salix exigua</i>	Coyote willow	Mod.	-	-	-	-	-	1	1	2
<i>Salix gooddingii</i>	Goodding willow	Mod.	-	2	-	1	-	1	2	3
<i>Schoenoplectus maritimus</i>	Threesquare	Mod.	-	2	-	-	-	1	-	2
<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush	Low	-	-	-	-	-	-	1	-
<i>Solidago</i> sp.	Goldenrod	Low <sup>b</sup>	-	1	-	1	-	-	-	-
<i>Sporobolus airoides</i>	Alkali sacaton	Low <sup>b</sup>	-	-	-	-	-	-	1	-
<i>Tamarix ramosissima</i>	Salt cedar	High	4	4	4	4	4	4	3	3
<i>Typha latifolia</i>	Cattail	Mod.	-	-	-	-	-	-	1	-
<i>Xanthium strumarium</i>	Cocklebur	Low <sup>b</sup>	-	-	1	-	-	1	1	-

<sup>a</sup>4 = high frequency; 3 = medium frequency; 2 = low frequency; 1 = trace species

<sup>b</sup>Categorized as low because supporting data unavailable.

Figure 3. Estimated Frequency of Plant Species in Vicinity of Sample Locations

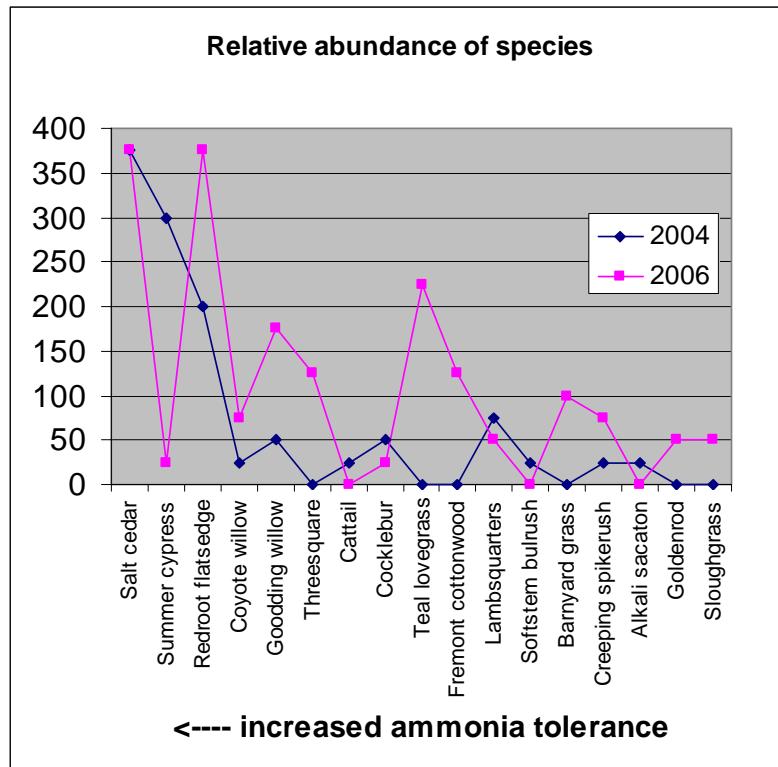


Figure 4. Relative Abundance of Species in Vicinity of Sample Locations